

# Good Nutrition Strengthens Cattle Immunity

**W**hen people get the flu, they guzzle down orange juice. But for sick steers, a balanced protein feed might be just the thing.

Animal scientist Ted H. Elsasser, who is with the ARS Growth Biology Laboratory in Beltsville, Maryland, has found several connections between nutrition and how cattle fight illness.

When germs are detected by a steer's body, its immune system releases cytokines, a chemical "call-to-arms" for cells to attack the microbial invaders. Cytokines also trigger other cells to produce inorganic defense molecules such as nitric oxide.

But sometimes the immune system goes into overdrive. Too many of the cytokine messengers are released, and the result is metabolic shock and cardiopulmonary failure. Newborn calves, for example, will sometimes die when their immune systems overrespond to ordinary barnyard bacteria.

Nutrition may, however, be a tool to modulate cytokine release.

"We did research here at Beltsville with a group in Switzerland. We looked at a high-protein versus a moderate-protein diet," Elsasser says. "We found that cytokine response to a simulated bacterial toxin was significantly reduced at the higher level of protein."

But why does the immune system overreact? Elsasser believes that the cytokine-nitric oxide response system may be out of sync with modern animals' physiology.

"What's happening is the result of lost regulatory control. You're dealing with systems that are quite ancient compared to where animals have evolved," Elsasser says.

He says he looks at disease resistance in animals as a triangle of defense: the immune system, digestive system, and endocrine system all working together to fight infection.

Researchers at ARS' Growth Biology lab have a special way to make a steer's body conduct a "fire drill" of how it responds to infectious disease. They inject cattle with bacterial extracts called endotoxins.

"We look at a low-level challenge of endotoxins," says Elsasser. "Actually, we just tickle the biology and look for outside clues, such as raised body temperature and appetite loss."

In his latest research, Elsasser found that a steer's response to disease—and subsequent weight loss—is more complicated than anyone suspected.

"There are two sides to animal nutrition; not only what the animal eats, but what its cells can absorb and use," he says. "The timing, patterns, and amounts of metabolic hormones dictate how a cell will absorb and use

nutrients. The pancreas is vital in this process. If you compromise the outflow of pancreatic hormones such as insulin, you compromise the ability of other tissue to use nutrition."

Elsasser's first clue towards discovering this pancreatic connection came during an experiment in which steers became more ill during an endotoxin challenge when they were fed marginally nutritional diets.

Of all the organs affected, the pancreas was more intensely affected and for a longer time. Cells in the pancreas were making nitric oxide-producing enzymes at rates several times that of healthy steers. Nitric oxide—when too much is produced—can break down to form free radicals that injure cell proteins.

This means veterinarians will have to rethink the pancreas' role during animals' illness. It also further confirms the triangle theory of disease response: that digestive, immune, and endocrine systems fight infection as a team.—By **Jill Lee**, ARS.

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